



# Rain Gardens

## *Technical Guide*

*A landscape tool  
to improve water quality*



Virginia Department of Forestry

[www.dof.virginia.gov](http://www.dof.virginia.gov)

# Acknowledgements

This publication, developed by Stephanie Keys Golon and Dr. Judith Okay for the Virginia Department of Forestry, is available from the Virginia Department of Forestry, 900 Natural Resources Dr. Charlottesville, VA 22903 Phone: 434-977-6555 Web site: [www.dof.virginia.gov](http://www.dof.virginia.gov).

The publication of this document would not have been possible without the support of J. Michael Foreman, formerly with Virginia Department of Forestry. His strong belief in public outreach and education and his ability to gather financial support through the Potomac Watershed Partnership is greatly appreciated.

The following individuals contributed to the publication through their suggestions and/or editing:

Barbara White, Virginia Department of Forestry

Carol Heiser, Virginia Department of Game and Inland Fisheries

Christin Jolicoeur, Northern Virginia Soil and Water Conservation District

Jennifer Schill, The Potomac Conservancy

Margaret Bryant, Department of Landscape Architecture, Virginia Polytechnic Institute and State University

Christin Jolicoeur, Nicholas Kokales, Willie Woode - Northern Virginia Soil and Water Conservation District for help with survey logistics

**Garden Graphics were provided by:** Jeremy Hinte, Department of Landscape Architecture, Virginia Polytechnic Institute and State University

A special thanks to John Campbell and Janet Muncy, Virginia Department of Forestry, Public Information Division, for their professional review and additions to this publication.



# Contents

	Page
Introduction .....	3
What is a Rain Garden? .....	4
How Do I Begin? .....	5
How Does My Rain Garden Work? .....	6
Where Should I Locate My Rain Garden? .....	6
Survey the Land .....	8
Your Soil .....	9
Determine the Area of the Rain Garden .....	10
Cost of Supplies .....	11
Plant Selection .....	13
Building the Rain Garden .....	14
Maintenance .....	16
Rain Garden Designs .....	17
Glossary .....	21
Additional Resources .....	22

## APPENDICES

Appendix A: Water Quality Protection Tips .....	23
Appendix B: A Good Habitat .....	24
Appendix C: Conversion Chart .....	25
Appendix D: Plant Selection Guide .....	26

## LIST OF TABLES AND FIGURES

Figure 1. Forest Function Changes with Development .....	4
Figure 2. Illustration of Forest Function .....	5
Figure 3. Cross Section of a Rain Garden .....	6
Figure 4. Site Inventory .....	7
Figure 5. Graph of Survey Data .....	9
Table 1. Runoff Value for Rain Garden Calculations .....	11
Table 2. Appropriate Retail Price for Supplies .....	12
Table 3. Maintenance Schedule .....	16

## Foreword

This guide has been compiled as a resource for individuals, groups and organizations interested in creating a landscape feature that will: solve drainage problems, address erosion problems, improve water quality, create wildlife habitat, and/or create a garden focal point. We hope homeowners, teachers, community leaders, gardeners, and landscape architects will find this information useful.

The Virginia Department of Forestry has shown leadership in promoting Rain Gardens for improved water quality for many years. Demonstration projects have been implemented throughout the state and partnerships have been formed for these projects, resulting in agencies, organizations and citizens becoming interested in the concept of Rain Gardens. It has become clear that there is a need for a guide that landowners can use to develop a Rain Garden on their property. This concept is an element of planning low-impact development, retrofitting older development, and creating natural solutions to drainage and erosion problems.

It is the intention of this guide to limit the technical jargon found in manuals designed for engineers, without losing the purpose and integrity of the bio-retention concept. It is also the intention of this guide to present the sources of information and guidance necessary to avoid mistakes that would be troublesome to landowners, their neighbors or jurisdictional ordinances.





# Introduction

Rain is an important occurrence in nature because it replenishes water supplies, provides moisture for living resources and maintains flow levels of rivers and streams. There are also negative effects that rain can cause due to human interactions. All deposited pollutants on surfaces wash away with rain and flow overland to the nearest waterway. Examples of less desirable substances that are carried in storm water runoff are petroleum products, animal waste, fertilizers, pesticides, and household chemicals. Although we use these substances in our daily lives, how can we protect our waterways? The first line of defense is to alter human behavior in a positive direction. A secondary means of protecting our waterways from pollution is the use of practices that intercept storm water runoff before it enters the waterways.

The landscape of Virginia is ever changing, and, for several decades, we have witnessed the conversion of rural areas to urban. This conversion has created areas with less forests and increased impervious cover, such as sidewalks, roads and roofs. This has amplified the amount of storm water runoff that is being carried directly to streams and lakes with little or no treatment. Problems created by urban and rural runoff include increased pollutants and temperatures in waterways, increased flooding, and increased costs for municipalities.

On a regional level, municipalities have developed catch basins—known as storm water management ponds—to gather storm water from developed land with impervious surfaces. The storm water ponds are intended to mimic forested floodplains in their retention of water and the beneficial removal of nutrients. Although there are many jurisdictions that are not yet employing these methods of storm water management, many communities were developed before storm water management was required.

The natural resource consequences of traditional storm water management practices without volume controls include: stream degradation, soil erosion and nutrient loading of waterways, loss of in-stream and corridor habitat, and riparian buffer loss along streams. It is through new technology in current development and older, pre-storm water management development that water quality improvement goals can be met.

Bio-retention is the most current practice used to minimize impacts of storm water runoff. Bio-retention takes several forms, which include grassy swales, engineered wetlands, and Rain Gardens. Each of these practices employs physical water retention and biological and chemical interaction among soil, vegetation and water. All of these practices mimic one or some of the functions of a riparian forest buffer. In altered or urban landscapes, the use of bio-retention practices mitigates the amount of runoff from smooth, compact surfaces. The more impervious surface present in a landscape, the less rainwater that will infiltrate into the soil and recharge groundwater supplies. Figure 1 illustrates the effects of increased imperviousness.

There are many situations where the development of a Rain Garden would be beneficial. Placing a Rain Garden in your yard is easier than you may think. Follow the guidelines, plan well, and have fun. Your investment of time and resources will reward you for many years to come. For other water quality protection tips that you may use, refer to Appendix A.

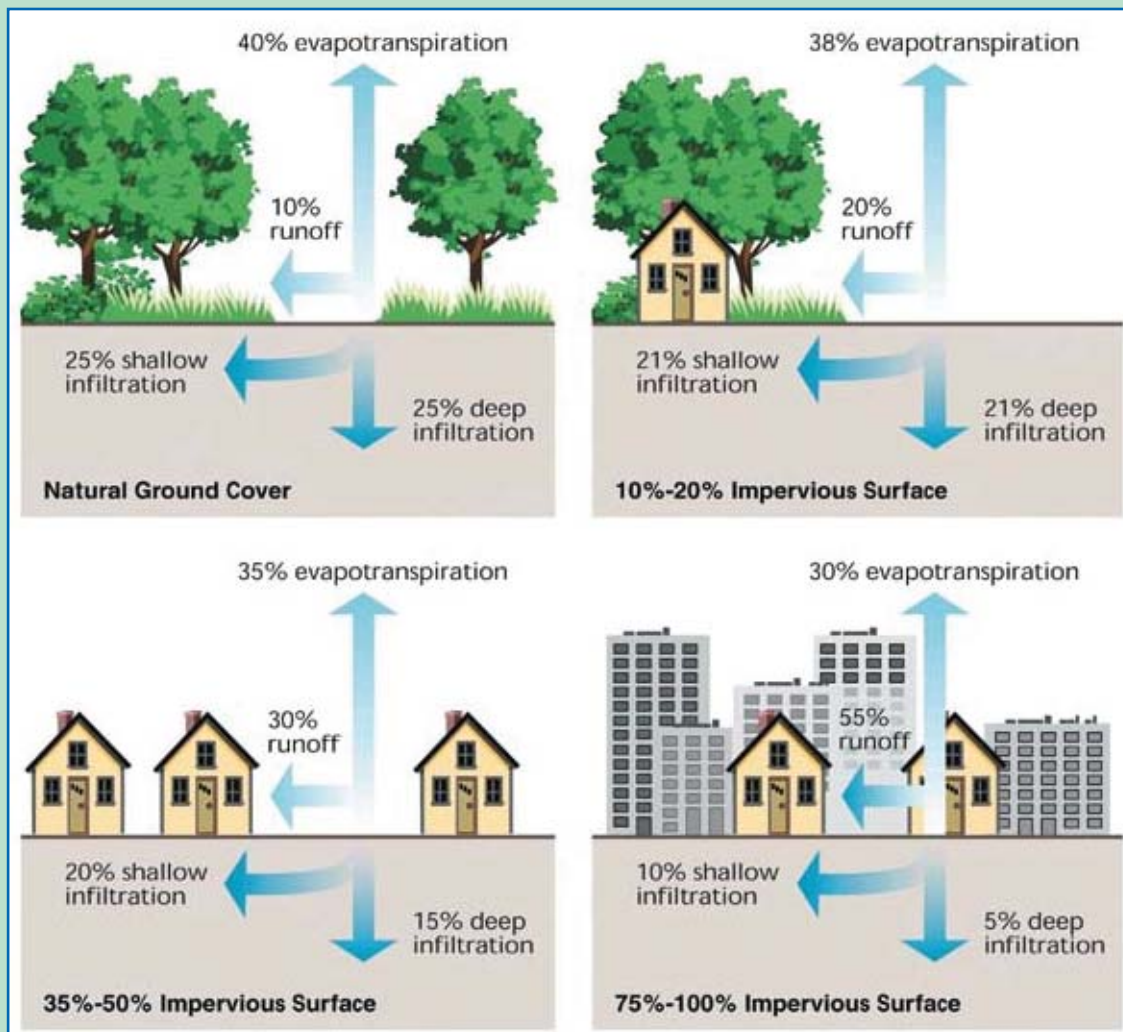


Figure 1: Forest function changes that take place with increased development  
[http://www.nrcs.usda.gov/technical/stream\\_restoration/schimage.htm](http://www.nrcs.usda.gov/technical/stream_restoration/schimage.htm)

## What is a Rain Garden?

A rain garden is just what the name implies—a garden planted with native plants that can be placed within your yard. It captures the first flush or runoff from a rain event. By capturing the runoff in the Rain Garden, you will not only provide runoff reduction benefits, you may also produce substantial neighborhood and community environmental benefits, such as:

- ◆ An increase in the vegetation mixture in your yard that will provide habitat for insects and birds;
- ◆ An enhancement of the beauty of your yard, thereby improving the landscape in your neighborhood;
- ◆ An increase in the amount of groundwater renewal;
- ◆ The bringing together of your family and neighbors for a fun, physical activity;
- ◆ Plant material that can provide shade and a light or noise screen, and
- ◆ A layer of vegetation to include a canopy, understory and ground cover.

You may think that a small, individual garden will not make a difference, but collectively they can make a great impact. This is a guide for your Rain Garden design, not a set of strict rules. Each site is different and the concepts can be applied many different ways. You do not have to be an engineer to build a rain garden. The garden can be as complex or as simple as you are able to provide, depending on time, space and budget. The rain garden does not require much space and can fit into existing landscapes or made into any shape.

## How Do I Begin?

We will design a Rain Garden that will capture the first flush of runoff from your impervious surfaces and will attempt to mimic the functions of a forest. Forests provide many benefits that reduce the negative effects of storm water runoff. These include interrupting and redirecting the flow of storm water, allowing for the percolation into the soil, and filtering pollutants from the water as it passes through the organic forest soils. Trees also remove nutrients and use them for growth, which in turn reduces erosion by leaf interception of water droplets and the root masses hold soil in place. Figure 2 illustrates the interaction between trees and rainfall.

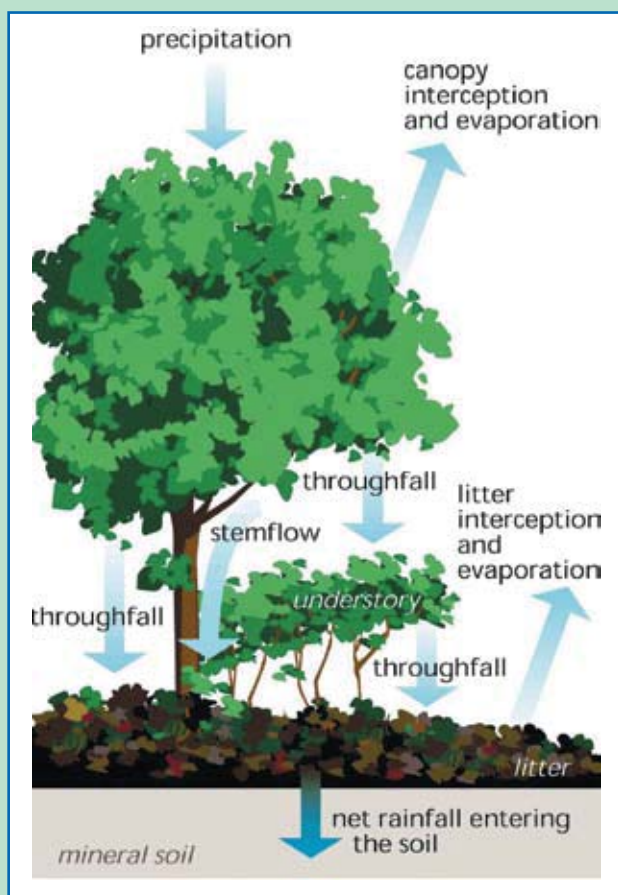


Figure 2. Illustration of forest function  
<http://www.nrcs.usda.gov/>

So, are we actually creating a forest by using the Rain Garden concept? No, but we are putting a system into the landscape that can provide functions that are missing because forests have been lost to urbanization.

In order for us to begin to learn how a Rain Garden works, we must first know the layers of the rain garden (refer to Figure 3). These layers include:

- ◆ A **grass buffer strip** around the garden that will slow the velocity of the runoff;
- ◆ A **mulch layer** will provide a medium for the biological activities to occur and will keep the soil moist;
- ◆ **Plants** that will use the runoff for moisture and nutrient requirements;
- ◆ A **soil layer** is where the plant roots will collect the moisture and nutrients for their growth;
- ◆ A **ponding area or depression** of the garden will provide the storage needed for the runoff, and
- ◆ A **berm** that is at least six inches of soil or rocks that works like a dam to pond the runoff.

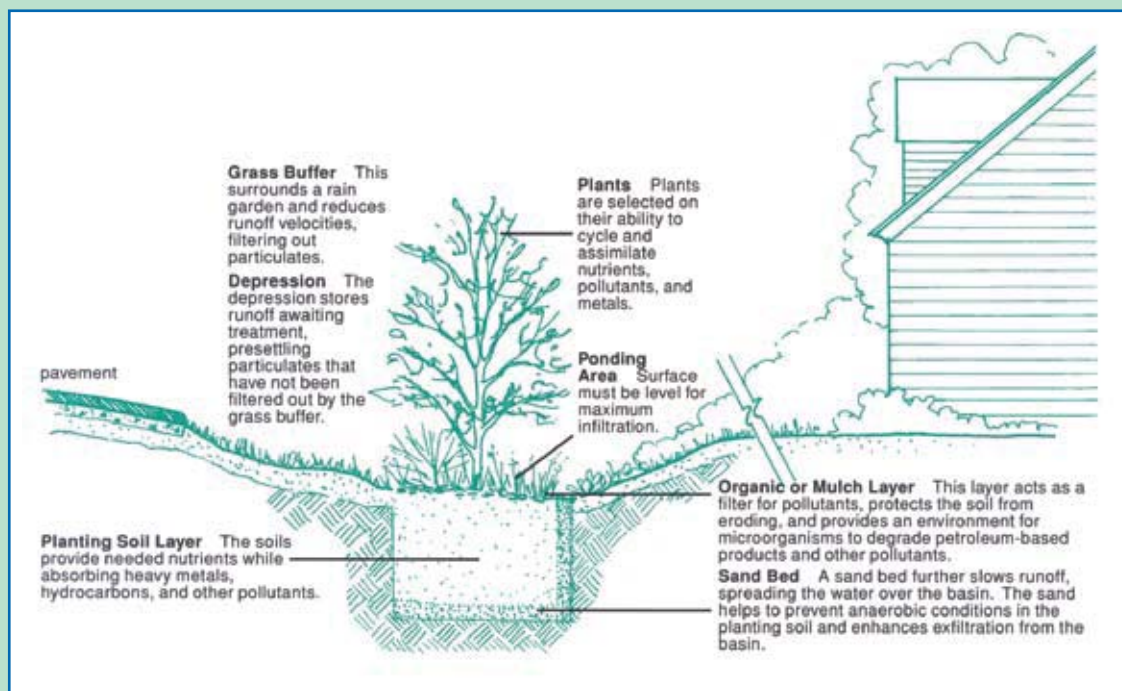


Figure 3: Cross section of a Rain Garden

<http://fairfaxcounty.gov/nvswcd/youyourland/landscape.pdf>

## How Does My Rain Garden Work?

Now that you know the layers of a Rain Garden, let's go into more detail on how this storm water management tool works. The Rain Garden is placed in a location to collect the runoff as a rain event occurs. The layers filter the runoff naturally as the runoff moves into and throughout the Rain Garden. The native plants and microorganisms found in the soil will remove the pollutants that are carried in the runoff from the roof and driveway. By preventing the runoff from going into a typical curb and gutter storm water system, you will help eliminate the pollutants from going directly into streams and lakes and, eventually, into the Chesapeake Bay.

## Where Should I Locate My Rain Garden?

There are several places that you may wish to consider when looking for a location for your Rain Garden. You may decide to place it near the house to catch the roof runoff, or you may place it farther from your house and collect the runoff from your lawn and possibly your driveway. You can decide where the best location will be. Sketch a drawing of your property similar to Figure 4.



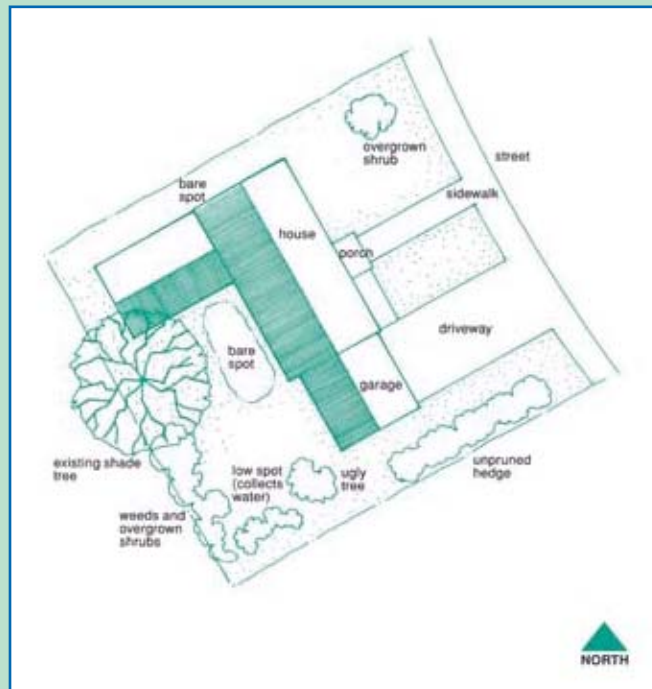


Figure 4. Site Inventory

<http://fairfaxcounty.gov/nvswcd/youyourland/landscape.pdf>

Placing your rain garden may be easy if there is a low spot in the landscape, but it is also possible in a relatively flat lot. Take a walk around the property and make note of high and low areas and areas where water naturally flows. Note areas around gutters, pavement, and outbuildings.

**Here are some ideas** to consider when planning the location of your Rain Garden:

- ◆ Do not remove or damage existing trees to construct the Rain Garden. If you would like to plant in the vicinity of an existing tree, please make sure you do not disturb the soil or roots. Make sure the garden is located outside the drip line of the tree.
- ◆ You may feel that a location where water already ponds in your yard may be appropriate, but it is NOT. This is a location where the soil does not allow adequate infiltration and is not a good place for the Rain Garden. You will want a section of soil that has adequate infiltration, the procedure to test for this can be found on page 9.
- ◆ Know where your utility lines, such as electric, sewer, water and gas, are located before you decide the garden location. Call Miss Utility. You would not want to place a great deal of effort into a garden that will be dug up by a utility company.
- ◆ Pick out a location that is at least 10 feet from your home. You do not want a flooded basement or leaky foundation.
- ◆ Choose a site that does not have a steep slope. Slopes that are greater than 12% will take much more effort to design and may not be as effective.
- ◆ Know where your water table is located. You do not want the Rain Garden to directly interact with your water table.
- ◆ Take into consideration the views from inside and outside your home. Why not place the garden near a large window or near your patio so that you and your family can enjoy the beauty of the garden all year long?
- ◆ Use native plants when possible as they usually are better adapted.

## Survey the Land

Once you have determined the location of your Rain Garden, the following steps will help you get the lay of the land (elevations). Once you know the elevation differences of the Rain Garden area, you will know the extent of soil removal or replacement needed to make the garden ponding area level.

**There are certain tools you will need to determine the slope of the land. It is really a task that requires three people. The following tools will be helpful: two yardsticks - a tape measure - string - a line level - paper - pencil.**

- ◆ Tape the yardsticks together with a clear tape; you now have a six-foot survey rod.
- ◆ One person (Person #1) holds the yard sticks/survey rod and this person will move around the property.
- ◆ The second person (Person #2) has the beginning of a tape measure or string of a known length (minimum 25-ft. length).
- ◆ Person #1 with the rod holds the other end of the string/measure tape.
- ◆ Place the line level on the string or tape.
- ◆ Person #2 holds the string at eye level—the eye level height will be used as a benchmark for all other measurements. (Keep the string at eye level until measurements are complete.)
- ◆ Person #1 Moves the string up the rod until the line is level with Person #2. Then read the number off the rod, be sure to add the height on the second yardstick to that of the first. (Example: if the string is on 24 inches on the second yardstick, the number is actually 5 feet—3 feet on the first stick plus 2 feet on the second.)
- ◆ The third person (Person #3) will determine the line is level when the bubble on the line level is in the middle of the level. He or she will also be the recorder for the heights.
- ◆ Person #2 stays put while persons #1 and #3 move down the tape measure horizontally repeating the leveling procedure at each foot or 2-foot increment along the tape or string.
- ◆ Then start another survey line with person #2 still standing in the original spot and persons #1 and #3 moving in another direction from #2.



Person #1



Person #2



Person #3



After you have completed at least 4 transects or lines from the center (position of person #2), plot each transect on a sheet of graph paper with the length being the x axis and the elevation being the y axis. Refer to Figure 5. The line on the graph demonstrates to you the high and low spots across the bottom of the garden site. This will help determine the soil removal or additions to get a level ponding area.

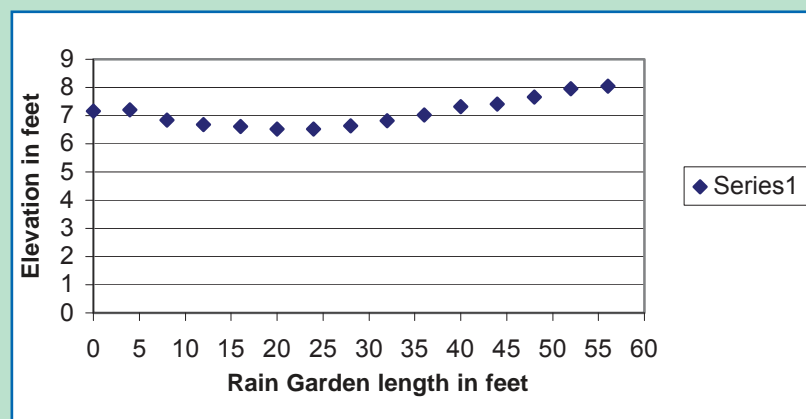


Figure 5. Graph of survey data

## Your Soil

In Virginia, we have varying soils. We recommend contacting your local extension office for assistance with your decisions involving nutrients and pH. We will give you a simple process that can help you test your infiltration rate. You can test your drainage by digging a hole six inches wide and 18 inches deep. Pour water into the hole and observe how long it takes for the water to infiltrate into the soil. If the water has not infiltrated within 48-72 hours, then you will need to amend your soil to improve infiltration or choose another location for your Rain Garden.

## What If My Soil Needs Amending?

If your site does not have good infiltration, we recommend blending a mixture of amendments to improve the drainage. The recommended soil replacement mix is 50% sand, 25% topsoil (no clay) and 25% compost or leaf mulch. These supplies can be bought in bags from most home and garden stores or can also be purchased in bulk, depending on the size of your job. If you choose bagged amendments, avoid purchasing sterile soil.

## Determine the Area of the Rain Garden

### Depth

If you have checked your soil using the infiltration test and found that it has adequate infiltration and you do not need to amend your soil, then you may just need to excavate the area for the ponding depth of no more than six inches. You will not want your ponding depth to be greater than six inches because of the possibility that the ponded water could be retained longer than 96 hours. After 96 hours, the area would be prone to mosquitoes breeding, along with other undesirable insects.



If your infiltration test led you to amend your soil, then you will need to excavate the maximum six inches for ponding and three feet for ideal conditions. We recommend three feet of amendments to provide sufficient depth for plant root growth and for moisture capacity. You must also be able to determine where your water table is located. You do not want to go three feet, if this interacts with your water table. If you must locate your Rain Garden in the location that needs soil amendments, please count on the Rain Garden taking more time and money, so plan accordingly. If your location has extremely poor soil conditions, a layer of gravel or stone may be placed into the bottom of the Rain Garden to increase storage.

### Width and Length

As you are planning your Rain Garden, visualize how the water will be directed to the garden and how it will be stored. You want to distribute the water evenly throughout the garden so that the entire garden gets equal amounts of flow. To help alleviate a potential excess ponding problem, you should place the Rain Garden length perpendicular to the flow of the runoff so that it can catch as much water as possible. You also want the Rain Garden to be wide enough to ensure sufficient room for plant variety and spacing and enough room for the water to be distributed over the bottom of the garden. A good rule of thumb is that the garden should be at least twice as long as it is wide.

When deciding your width and depth of the garden, keep the slope in mind. Rain Gardens that are on very steep slopes and extremely wide gardens will need to be dug much deeper on one side than the other in order to be level. Garden shapes can vary; the square footage is the most important feature to consider. Decide on the size garden that suits your site. We should state that the calculations are guidelines to include 100% of the runoff into the garden. If size or cost becomes an issue, it is acceptable to construct a smaller rain garden.

The size of the garden must be large enough to hold the water within the drainage area. The kind of surface the water is flowing over is important because that will determine how much will run off and how much infiltrates into the surface. For this reason, there is a runoff value that needs to be determined. Here are some examples of drainage area sizes and runoff values. For parking lots, roofs and other pavement the runoff value = 0.9; for turf it is 0.25. As stated by Prince George's County Design Manual For Use of Bio-retention In Storm Water Management, the garden size should be 7% of the runoff surface area multiplied by the runoff value.



**Step One: Calculate the square footage of the Impervious Surfaces.**

Roof - 50 ft. x 50 ft. = 2500 sq. ft.

Driveway - 12 ft. x 20 ft. = 240 sq. ft.

Concrete Patio - 15 ft. x 12 ft. = 180 sq. ft.

Total impervious surface = 2920 sq. ft. = runoff surface area

**Step Two: Calculate the square footage of the Pervious Surfaces.**

Lawn Area 50 ft. x 30 ft. = 1500 sq. ft.

**Step Three: Multiply the square footage obtained in Steps One and Two by the appropriate runoff coefficient from Table 1 and by the 7% of runoff.**

2920 sq. ft. (impervious surfaces) x 0.07 (percent of runoff) x 0.9 (runoff value) = 183.96 sq. ft.

1500 sq. ft. (lawn area) x 0.07 (percent of drainage) x 0.25 (runoff value) = 26.25 sq. ft.

**Step Four: Add both impervious and turf areas together to get total Rain Garden size.**

183.96 sq. ft. + 26.25 sq. ft. = 210.21 sq. ft.

We will need to install a Rain Garden that is 210.21 sq. ft. in order to accommodate 100 percent of the runoff from the property – a 17.5 ft. x 12 ft. or a 10 ft. x 21 ft. garden design would work.

Table 1: Runoff value for Rain Garden calculations

Type of Surface	Runoff Value
Roof, parking lot, concrete walks, decks, patios and driveways	0.9
Lawn, woodlot, turf, playing fields and planted garden beds	0.25

## Cost of Supplies

To determine the approximate cost of the sample garden (210 sq. ft.), use the calculations and prices from Table 2. The soil amendment calculations are for the 210 sq. ft. garden, the six inches of ponding and three feet of soil amendments to replace the soil that does not have adequate infiltration. We are using bulk amendments and mulch.

**Step One: Calculate the amount of compost, topsoil and sand you will need.**

Find the cubic footage of your garden. Multiply the size of the Rain Garden by the three feet of soil amendments.

210 sq. ft. x 3.0 sq. ft. = 630 cu. ft.

Now determine the percentage of each item to be included. The recommended soil replacement mix is 50% sand, 25% topsoil (no clay) and 25% compost or leaf mulch.

**Sand:**

50% of the 630 cu. ft. is 315 cu. ft.

**Topsoil:**

25% of the 630 cu. ft. is 157.5 cu. ft.

**Compost or Leaf Litter:**

25% of the 630 cu. ft. is 157.5 cu. ft.

Now we know our needs of each medium in cubic feet, we can decide how many yards we need to purchase (1 cu. yd. = 27 cu. ft.).

**Sand:**

$$315 \text{ cu. ft.} \div 27 \text{ cu. ft.} = 12 \text{ cu. yd. of sand}$$

**Topsoil:**

$$157.5 \text{ cu. ft.} \div 27 \text{ cu. ft.} = 6 \text{ cu. yd. of topsoil}$$

**Compost:**

This item may be free if you have a compost pile or decide to use leaf litter. But we will also include the price for your consideration.

$$157.5 \text{ cu. ft.} \div 27 \text{ cu. ft.} = 6 \text{ cu. yd. of compost}$$

**Step Two: Calculate the amount of mulch you will need:**

We will want the mulch to be at least 3 inches (0.25 ft) deep. So to find the cubic feet of mulch, multiply the square footage of your garden by the depth.

$$210 \text{ cu. ft.} \times 0.25 \text{ ft} = 52.5 \text{ cu. ft. of mulch}$$

Now we need to know how many yards of mulch.

$$52.5 \text{ cu. ft.} \div 27 \text{ cu. ft.} = 2 \text{ cu. yd. of mulch}$$

**Step Three: Calculate your excavation costs.**

If you choose to amend your soils and decide to rent a small piece of equipment, such as a backhoe, this will be an additional charge of \$160-\$200 per day. You may also want to think about being able to operate this type of equipment and decide if you need to hire a professional to assist you with the installation of your garden.

Table 2: Approximate retail price for supplies (check local sources for current prices)

Supplies	Amount Needed	Price (\$)	Total Cost (\$)
Mulch	2 cu. yd.	\$26/cu. yd.	\$52
Sand	6 cu. yd.	\$16/cu. yd.	\$96
Compost	6 cu. yd.	\$32/cu. yd.	\$192
Topsoil	12 cu. yd.	\$26/cu. yd.	\$312
Native Plants	Approx. 30	\$2-15/plant	\$60-450
Excavator	1	\$160-200/day	Cost Varies
<b>Approximate Cost</b>			<b>\$712-\$1,102</b>

## Plant Selection



Joe Pye Weed  
Virginia Department of Forestry



Jerusalem Artichoke  
Virginia Department of Forestry



Great Blue Lobelia  
Jennifer Anderson  
USDA-Plants Database

When you are deciding what types of native plants you would prefer for your garden, consider that the Rain Garden will have various zones where different kinds of plants will thrive. For example, the center and the deepest part of the garden will support the very wet to wet-loving plants. The middle of the side slope of the garden will support the wet to dry plants, and the upper rim of the garden will support the drier types of vegetation.

Other factors that you may consider when choosing the plants for your Rain Garden are the following:

- ◆ Sunlight, moisture and soil requirements.
- ◆ Decide on your objectives, such as what type of wildlife you would like to attract, then decide on the varieties you would plant to attract those species. Refer to Appendix B for additional habitat information.
- ◆ The location of the Rain Garden will help you to decide if you prefer fruit-bearing plants. If your Rain Garden is near the driveway or walkway, you may want to choose other varieties to avoid mess and cleanup time.
- ◆ Think about where your Rain Garden is located before you plant certain trees. You would not want to plant an oak next to a powerline or too close to your home.
- ◆ If planting near a road that receives chemical treatments in the winter, choose plants that are tolerant to salt. Your local nursery can help you make those decisions.
- ◆ Think about a color scheme and visual interest for each season of the year.
- ◆ We always recommend using plants **native** to your area. Please see contact information in the back of the guide to assist you in finding plants native to your area.
- ◆ To protect your home from forest fires, refer to [www.virginiafirewise.org](http://www.virginiafirewise.org).

## Why Native Plants?

- ◆ They are best adapted for the local climate and, once established, do not need extra water or fertilizer.
- ◆ Many are deep rooted, allowing them to survive droughts.
- ◆ Native plants are attractive to the diverse native pollinators (bees, butterflies, beetles and birds).
- ◆ Natives provide habitat and food for native wildlife.
- ◆ For plant selection, refer to plant list in Appendix D.



## Building the Rain Garden

After all your planning, you are ready to mark your calendar for construction day. We have found that spring is a better time of the year, but fall may also be an option. **The next task is to make sure that you call Miss Utility at 1-800-552-7001. Please call ahead, it may take up to a week for marking.**

### Step One: Site Preparation

Before excavation begins, use your plan and mark the Rain Garden areas on the ground with fluorescent spray paint. Also be sure to mark the area where you would like to locate the berm. Use the appropriate erosion controls if necessary. Silt fences or straw bale barriers can direct and contain sediment during construction. Please refer to The Virginia Department of Forestry Web site at: <http://www.dof.virginia.gov/wq/resources/BMP-Field-2003-Erosion-Control.pdf>. Whether or not you are amending your soil, you may need a piece of machinery (like the one pictured) to assist with the project. You may use a roto-tiller, backhoe or bobcat depending on how deep your Rain Garden will be. If you choose to dig by hand, then you may need other volunteers who can be on site to help with installation. Either way, you will need a means to remove the extra soil (wheelbarrow, garden cart, or truck). After you have had the soil amendments delivered, the equipment placed on site, and have called Miss Utility, you are ready to dig. Please use caution when operating any equipment, and provide hard hats for those working on the ground.

### Step Two: Excavation

Dig your garden the size, shape and depth that you have determined for your location. You may need to use the survey rod that you made yourself from the previous section or use other survey equipment to assist you with keeping track of how deep you have dug. Once you have excavated to the desired depth, use a hand level or survey equipment to make sure that the bottom of your garden is level throughout. If you have areas that are lower than the rest, you will have problems with too much ponding in that area.

### Step Three: Amending the Soil

After the excavation is complete and the excavated soil has been removed from the location, you are ready to mix and add your amendments. You can choose to do this by hand or with the piece of machinery you are using. We have found it best to mix and add small portions of the amendment at a time. Using a wood stake and a string, mark the depth of the ponding area that you plan to leave so that you do not overfill the garden. Also, after the amended soil has been placed in the excavated area, allow it to settle overnight. After this time period, add additional soil if needed. Use the survey rod that you made yourself from the previous section or use other survey equipment to ensure that the area is level throughout.



#### Step Four: Constructing the Berm

To construct your berm, you will need to reserve soil that has been excavated from the Rain Garden. If you have clayey soil, this is one location where it is useful, or any well-packed soil will work. You will need to locate the highest part of the berm on the downhill side of your Rain Garden. The berm should not exceed 6 inches tall. Then the berm should gradually taper and lower on each side of the garden until the berm is integrated into the existing lawn.



Once you have the soil (preferably clay soil) in place, begin shaping and compacting the berm. Use your foot or tamping bar to compact because the berm will act as a dam for the runoff and will need to be firmly pressed together. As you compress the soil, smooth it into a gradually rounded berm. This will be visually pleasing and also help reduce the erosion of the berm. Seed and straw the area with your choice of grass seeds. To prevent erosion prior to the establishment of grass, you may chose to place burlap or other matting on the berm.

#### Step Five: Planting

Now that you have excavated the area and made any needed adjustments to the soil, you are ready to plant the plants that you have selected. This is so easy to do and can be a fun activity in which the entire family or neighborhood may participate.

If you chose not to amend your soils, you may choose to add compost or potting soils into the planting holes. Some reminders on planting:

- 💧 Dig the holes for planting shallow and broad and fill the hole gently but firmly. Do not step on the planted area to pack, this will only damage the plants' root system.
- 💧 Choose plants that are established, usually one to two years old. Ask the nursery to assist you with selecting the plants.
- 💧 If you have chosen a tree for your rain garden and the tree was dug properly at the nursery and is being planted under normal circumstances, staking should not be necessary. Please refer to the International Society for Arboriculture or Virginia Cooperative Extension Web site listed in additional resources section for further information.
- 💧 Water plants immediately after installation, whether or not the soil is already moist.
- 💧 Retain identification tags from plant material until the end of the warranty period.
- 💧 Plant shrubs 3 feet apart; plant perennials 1 foot apart; plant annuals 6-8 inches apart; plant trees 15 feet apart.

#### Step Six: Mulching

Mulch is applied over the soil of the Rain Garden to maintain moisture, prevent erosion, provide weed control and help improve soil conditions over time. We recommend using shredded hardwood mulch or hardwood chips. The supply should be aged at least six months, or your mulch may float away. There are a few do's and do not's that we must mention.

- ◆ To provide optimum results, apply 3 inches of mulch after the plant stock has been planted in the planting soil.
- ◆ If you have chosen a tree, mulch wide not deep around the tree. Do not fall for the desire to create a “mulch volcano.” The excessive mulch around the base of the tree will cause disease and damage to the tree.
- ◆ Use organic mulches, such as hardwood mulch, instead of inorganic mulches, such as recycled tires. Organic mulches decompose and benefit the soil.

## Maintenance

Maintaining your rain garden is not much different than maintenance already required by your landscaping. We have provided a brief outline for you to reference throughout the year. The first year, the plants may need watering to get them well established.

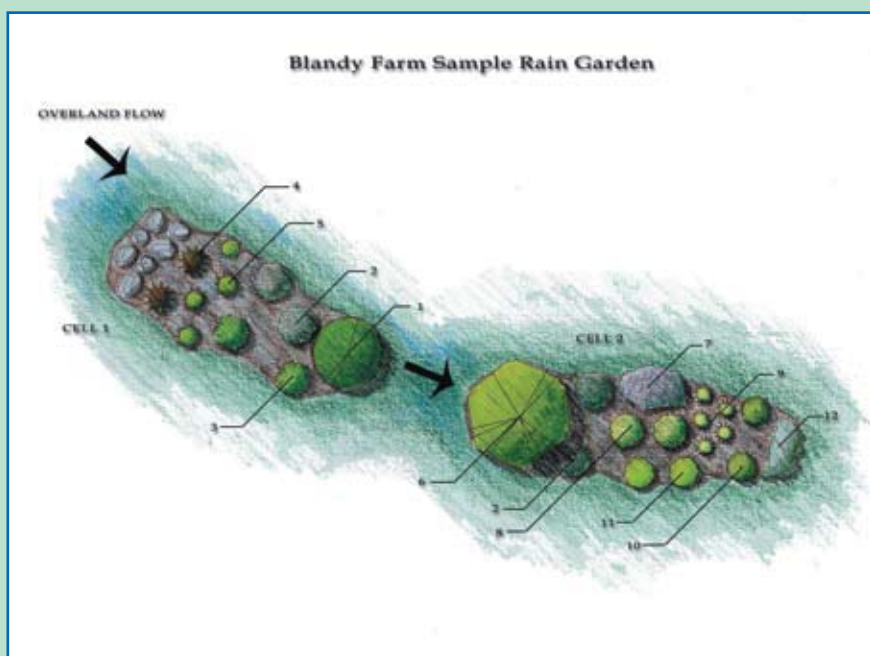
Table 3. Maintenance Schedule

Description	Task
Plant Material	<ul style="list-style-type: none"> <li>◆ Sunlight, moisture and soil requirements. Check plants periodically for signs of distress (wilting, yellow/brown leaves, etc.).</li> <li>◆ Weed as necessary.</li> <li>◆ Clean dead debris from plants after growing season and add to your compost pile.</li> </ul>
Berm	<ul style="list-style-type: none"> <li>◆ Check periodically for berm failure.</li> <li>◆ Do not allow plants other than grass to grow on berm because they could cause the berm to fail.</li> <li>◆ If water goes through rather than over the berm, this indicates failure.</li> <li>◆ Erosion ridges in berm could lead to failure.</li> </ul>
Ponding Area	<ul style="list-style-type: none"> <li>◆ If ponding area begins to retain water longer than specified time, then soil pores may have become clogged with particulate matter. If this occurs, you may need to replace the soil.</li> <li>◆ Check for the accumulation of sediment or debris and remove it.</li> </ul>
Soil	<ul style="list-style-type: none"> <li>◆ Check soil annually for excessive acidity or alkalinity.</li> <li>◆ If soil becomes compacted or if sediment clogs pores, soil layer may need to be replaced.</li> </ul>
Mulch	<ul style="list-style-type: none"> <li>◆ After the initial mulch layer has been applied, check periodically to ensure that rainwater has not washed out areas of mulch.</li> <li>◆ You may choose to add a new mulch layer every year, either in the fall or spring.</li> </ul>

## Rain Garden Designs

The following gardens are actual gardens depicted graphically as well as with digital photos. The plant lists should be referenced to the graphic design. They are gardens that can be copied if individuals find them suitable for their own sites. Be conscious of the placement, light requirements and wildlife values of the plants listed. Check with a local nursery to find other suitable plants that can be substituted in these designs. There is an extensive list of plants located in Appendix D.

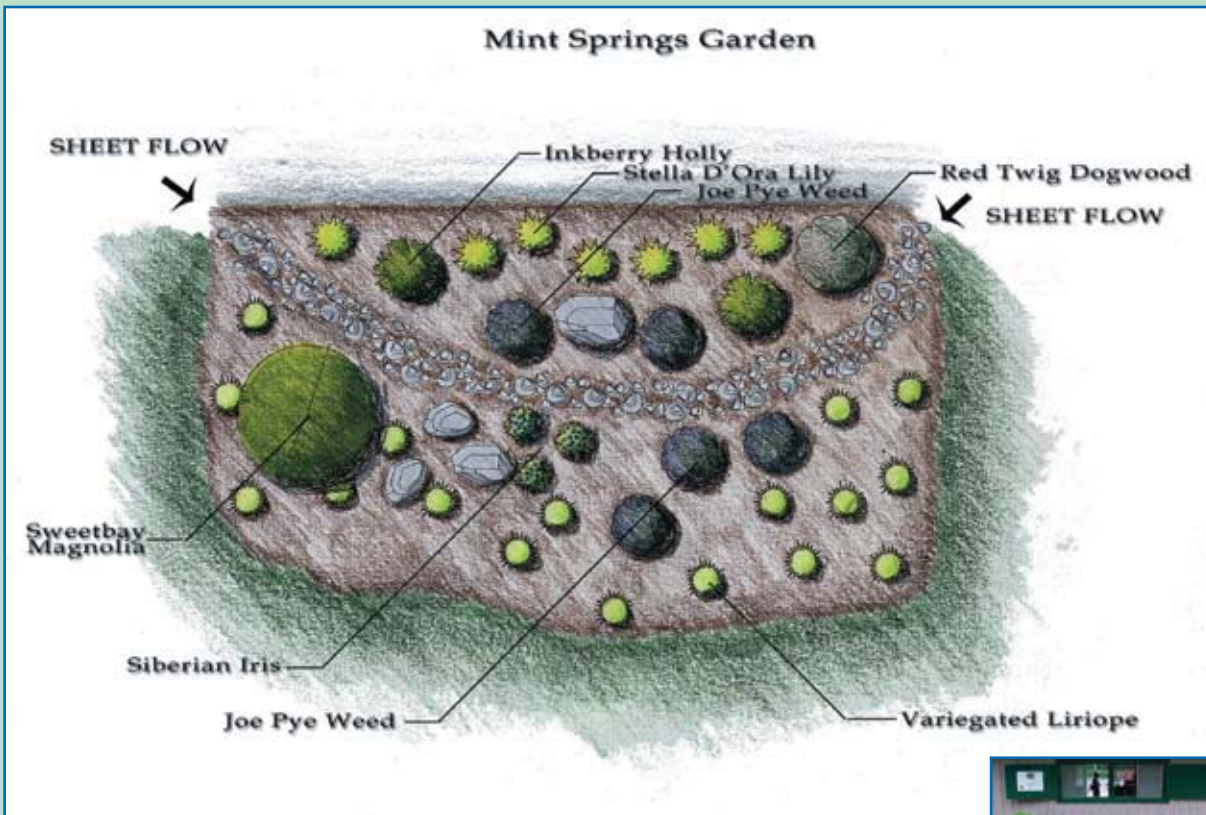




## Blandy Farm Sample Garden Plant List

Plant Species	Description	Height	Wildlife Value	Moisture Tolerance	Light Needs
1. Sweetbay Magnolia <i>Magnolia virginiana</i>	Small tree with large white fragrant flowers, red seed	10-20 ft.	Pollinators and seed for large birds/small mammals	Moderately Wet to Dry	Full Sun to Shade
2. Red Twig Dogwood <i>Cornus sericea</i>	Woody, red-stemmed shrub with white flowers and berries	10 ft.	Pollinators, birds and small mammals	Very Wet to Dry	Full Sun to Shade
3. Winterberry Holly <i>Ilex verticillata</i>	Shrub with red berries	10 ft.	Pollinators, birds and small mammals	Wet to Very Wet	Partial Sun to Shade
4. Cardinal Flower <i>Lobelia cardinalis</i>	Perennial with red flowers on spike	3-4 ft.	Pollinators including hummingbirds	Moderately Wet to Very Wet	Full Sun to Partial Shade
5. Turtle Head <i>Chelone glabra</i>	Tall spikes with pink, red, white flowers	3-4 ft.	Insect pollinators	Moderately Wet	Partial Sun to Shade
6. River Birch <i>Betula nigra</i>	Medium tree with weeping branches and peeling tan bark	40 ft.	Seeds for songbirds, particularly finch	Moderately Wet to Dry	Partial Sun to Shade
7. Joe Pye Weed <i>Eupatorium maculata</i>	Perennial with lavender flat flowers	4-6 ft.	Insect pollinators, particularly butterflies, and songbirds	Wet to Moderately Dry	Full Sun to Partial Shade
8. Witch Hazel <i>Hamamelis virginiana</i>	Shrub with yellow flowers in fall	8-10 ft.	Small birds	Moderately Wet to Dry	Full Sun to Partial Shade
9. Goldenrod <i>Solidago sempervirens</i>	Perennial spike with gold flowers	2-3 ft.	Insect pollinators and songbirds	Slightly Wet to Dry	Full Sun to Partial Shade
10. Sweet Pepper Bush <i>Clethra alnifolia</i>	Small shrub	5-8 ft.	Pollinators including hummingbirds	Slightly Wet to Dry	Full Sun to Partial Shade
11. Hibiscus <i>Hibiscus moscheutos</i>	Large perennial with snowy flowers - variety of colors	3-5 ft.	Pollinators particularly hummingbirds	Wet to Very Wet	Full Sun to Partial Sun
12. Siberian Iris <i>Iris siberica</i>	Small perennial with blue flowers	2 ft.	Insect pollinators	Moderately Wet to Very Wet	Full Sun to Partial Shade



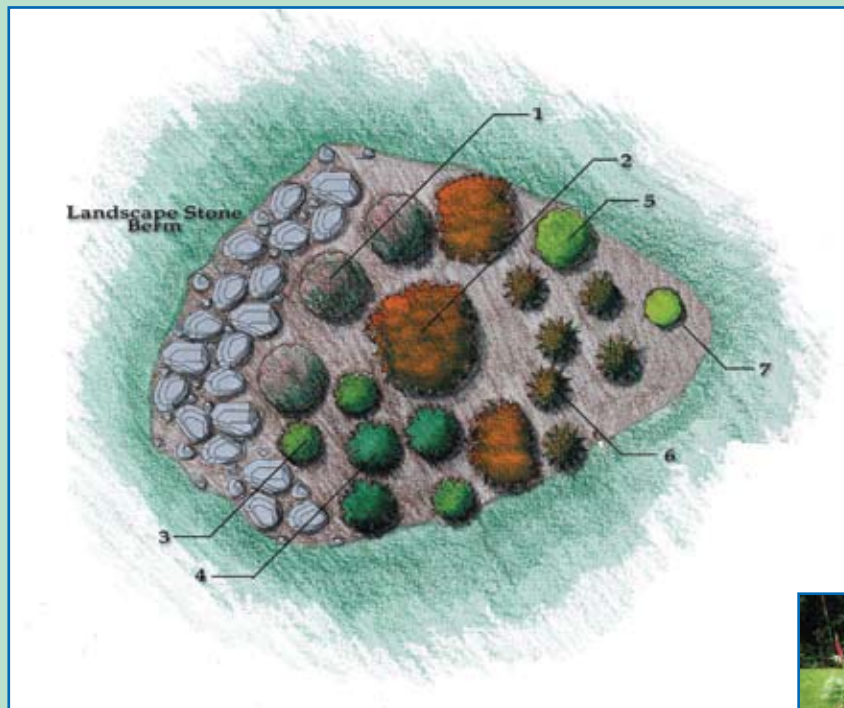


## Mint Springs Sample Rain Garden Plant List

Plant Species	Description	Height	Wildlife Value	Moisture Tolerance	Light Needs
1. Stella Dora Lily <i>Hemerocallis</i>	Dwarf yellow daylily, green soft-stemmed plant	12-17 in.	Pollinators	Moderately Wet	Full Sun to Partial Shade
2. Ink Berry Holly <i>Ilex glabra</i>	Evergreen woody shrub	4-8 ft.	Birds	Moderately Wet to Very Wet	Full Sun to Partial Shade
3. Joe Pye Weed <i>Eupatorium maculata</i>	Perennial with lavender flat flowers	4-6 ft.	Insect pollinators, particularly butterflies, and songbirds	Wet to Moderately Dry	Full Sun to Partial Shade
4. Red Twig Dogwood <i>Cornus sericea</i>	Woody, red-stemmed shrub with white flowers and berries	10 ft.	Pollinators, birds and small mammals	Very Wet to Dry	Full Sun to Shade
5. Sweetbay Magnolia <i>Magnolia virginiana</i>	Small tree with large white fragrant flowers, red seed	10-20 ft.	Pollinators and seed for large birds/small mammals	Moderately Wet to Dry	Full Sun to Shade
6. Variegated Liriope <i>Liriope platphylla</i>	Large perennial with snowy flowers - variety of colors	3-5 ft.	Pollinators particularly hummingbirds	Slightly Wet to Dry	Full Sun
7. Siberian Iris <i>Iris siberica</i>	Small perennial with green fleshy leaves and deep blue flowers	2 ft.	Insect pollinators	Moderately Wet to Very Wet	Full Sun to Partial Shade

All shrubs should be spaced 3 to 5 ft. apart.

All perennial plants should be spaced 12 to 15 in. apart.



## Solomon Sample Rain Garden Plant List

Plant Species	Description	Height	Wildlife Value	Moisture Tolerance	Light Needs
1. Red Twig Dogwood <i>Cornus sericea</i>	Woody, red-stemmed shrub with white flowers and berries	10 ft.	Pollinators, birds and small mammals	Very Wet to Dry	Full Sun to Shade
2. Daylilies <i>Hemerocallis sp.</i>	Spike foliage with orange flowers, leafy green plant	2-3 ft.	Pollinators	Moderately Wet to Dry	Full Sun to Shade
3. Royal Fern <i>Osmunda regalis</i>	Tall fronds, delicate structure, leafy green plant	2 ft.	Shelter for amphibians and insects	Very Wet	Partial Shade to Shade
4. Cinnamon Fern <i>Osmunda cinnamomea</i>	Tall leathery fronds, leafy green plant	3 ft.	Shelter for amphibians and insects	Very Wet	Full Sun to Shade
5. Hibiscus moscheutos	Large flowers in multiple colors, strong green stem	3-5 ft.	Hummingbirds, butterflies and other insects	Very Wet	Full Sun to Partial Shade
6. Cardinal Flower <i>Lobelia cardinalis</i>	Perennial with red flowers on spike	3-4 ft.	Pollinators including hummingbirds	Moderately Wet to Very Wet	Full Sun to Partial Shade
7. Pickerelweed <i>Pontederia cordata</i>	Purple spike flowers, green heart-shaped leaves	2-3 ft.	Pollinators and shelter for amphibians and insects	Very Wet	Full Sun

All shrubs should be spaced 3 to 5 ft. apart.

All perennial plants should be spaced 12 to 15 in. apart.

# Glossary

**Amend** - to change for the better; to improve; to add to

**Berm** - a bank of earth

**Bio-retention** - a depressional area created to filter contaminants/pollutants from storm water

**Compaction** - the process of hardening under pressure

**Depression** - a lower position than surrounding area

**Drip Line** - line where the water drips from the outside edge of the tree canopy

**Elevation** - the rise of the land over a horizontal distance

**Excavate** - to dig out and remove

**First Flush** - the first rush of water carrying the most pollutants off impervious surfaces

**Herbaceous Plants** - plants with soft green stems that die to the ground each year

**Impervious** - a hard material, such as asphalt or rooftops, that stops water from soaking into the surface

**Infiltration** - the amount of water that can move through the soil pores from the soil surface

**Native Plants** - belonging in, or associated with, a particular geographic area

**Percolation** - to pass or trickle through a surface

**Perennial Plants** - plants that continue growth every year

**Pollution** - to make impure or unclean

**Runoff** - is the water that runs across surfaces during rain/snow events

**Sheet flow** - water flowing horizontally across the landscape

**Storm water** - water that results from heavy precipitation

**Survey** - to determine a position by taking measurements

**Swale** - a heavily vegetated low area in the landscape

**Topography** - feature of the landscape relative to position and height

**Transect** - a line crossed by other lines

**Tree Canopy** - the total area of the leaves and branches

**Water Table** - the surface where ground water meets the lower soil layer that is confining it

**Woody Plants** - plants that have a hard fibrous stem, such as shrubs and trees

# Additional Resources

## **Potomac Watershed Partnership**

<http://www.potomacwatershed.net/>

## **Virginia Department of Forestry**

<http://www.dof.virginia.gov/>

## **Chesapeake Bay Foundation**

<http://www.cbf.org/>

## **Virginia Native Plant Society**

Has a list of nurseries that carry native plants.

<http://www.vnps.org/>

## **Department of Conservation and Recreation**

"Native Plants for Conservation, Restoration and Landscaping"

[http://www.dcr.virginia.gov/natural\\_heritage/nativeplants.shtml](http://www.dcr.virginia.gov/natural_heritage/nativeplants.shtml)

## **Prince George's County Bioretention**

<http://www.co.pg.md.us/DER/ESD/Bioretention/Bioretention.asp>

## **Blue Ridge Community College**

[http://www1.brcc.edu/murray/research/Rain\\_Garden/default.htm](http://www1.brcc.edu/murray/research/Rain_Garden/default.htm)

## **Virginia Tech Soil Sampling Laboratory**

<http://www.ext.vt.edu/pubs/compost/452-129/452-129.html#toc>

<http://www.ext.vt.edu/pubs/waterquality/426-043/426-043.html>

## **Virginia Cooperative Extension**

<http://www.ext.vt.edu/resources/>

## **EPA Native Landscaping**

<http://www.epa.gov/greenacres/>

## **Additional Rain Garden Web sites**

<http://www.urbanwaterquality.org/RainGardens/rgindex1.htm>

## **International Society for Arboriculture**

<http://www.isa-arbor.com/>



# Appendix A

## Water Quality Protection Tips

### Ways To Improve Water Quality For Everyone's Benefit

- 💧 **Protect ground water and surface water**  
Properly dispose of unwanted engine oils, chemicals and hazardous fluids at participating recycling centers.
- 💧 **Select landscape plants wisely**  
Select native plants that need less water and fertilizer. Use mulches to help retain the moisture in those dry months. If watering is necessary, then water only in the early morning or late evening.
- 💧 **Routinely maintain septic systems**  
For the system to function properly, a septic system should be inspected and maintained every 3-5 years.
- 💧 **Integrate storm water management features into your home and yard**  
Create a Rain Garden, install a rain barrel or divert your downspouts to your lawn so that you may use the storm water runoff for your benefit.
- 💧 **Test soils prior to maintaining the yard**  
Improper use of fertilizers is a major source of nutrient pollution that clogs our waterways each year. Test the soils to identify the amount of fertilizer that is needed. Better yet, leave the clippings on the lawn and let the lawn fertilize itself. Compost also works great as a lawn and garden fertilizer.
- 💧 **Promote natural revegetation**  
Leave an unmowed buffer along the edge of the woods or along a waterway. This will provide additional habitat while improving water quality.
- 💧 **Dispose of animal waste properly**  
Pet waste contributes greatly to nutrient pollution. Scoop the waste and dispose in the proper receptacles.
- 💧 **Do not litter**  
Litter that is thrown on the ground or ditch ends up in our rivers, bays and oceans. Dispose of waste properly.
- 💧 **Plant a tree**  
Trees provide many natural benefits, such as cycling nutrients in water and air, providing wind and sun blocks, food for wildlife, erosion control and energy conservation.

# Appendix B

## A Good Habitat...



- ♦ provides food, water, and shelter for a variety of native wildlife species;
- ♦ incorporates the use of native plants in the landscape plan, and
- ♦ takes into account that plants and animals are interrelated in a complex food web.



You can create or improve a **HABITAT AT HOME®** by incorporating these main “ingredients”...

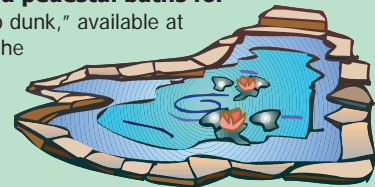
### **SHRUBS AND TREES that provide food and cover.**



- **Shrubs:** chokeberry (*Aronia*); chokecherry (*Prunus*); winterberry and inkberry (*Ilex*); bayberry and wax myrtle (*Myrica*); blackberry (*Rubus*); *Viburnums* (e.g. arrowwood, blackhaw, cranberry bush)
- **Trees:** black cherry (*Prunus serotina*); dogwoods (*Cornus*); hollies (*Ilex*); oaks (*Quercus*); eastern red cedar (*Juniperus virginiana*); blackgum (*Nyssa*); eastern white pine (*Pinus strobus*)
- Select deciduous shrubs for their flowering and fruiting quality and persistence. Group your plant material in clusters to provide maximum shelter for nesting birds. Be sure the overall composition includes evergreens that provide important protection from winter's cold and summer's heat. “Layer” the vegetation so that your habitat contains a variety of plant heights.

### **WATER SOURCES, such as shallow pools for amphibians and small mammals, and pedestal baths for songbirds.**

In small water features, you can avoid a mosquito problem by adding a “mosquito dunk,” available at local home garden centers. Mosquito dunks are slow-release, pest-control disks which contain the active ingredient Bt (*Bacillus thuringiensis*), a form of bacteria that kills mosquito- and black fly larvae but is non-toxic to other species. In larger water gardens, use a pump to circulate water, which discourages mosquitoes from laying eggs. Clean bird baths every few days with several quick swipes of a scrub brush and fresh water. Clean with bleach if algae has built up around the rim.



**NECTAR SOURCES for butterflies, hummingbirds, and other vital pollinators.** Examples include flowering shrubs like azalea (*Rhododendron*), pepperbush (*Clethra*), sweetspire (*Itea*), and buttonbush (*Cephalanthus*). Consider flower beds that favor native perennials, such as *Asters*, milkweeds (*Asclepias*), cardinal flower (*Lobelia*), coneflower (Echinacea), black-eyed Susan (Rudbeckia), goldenrod (Solidago), bergamot and bee balm (*Monarda*).

### **BIRD FEEDERS.**

There are numerous styles and designs of feeders on the market. A platform feeder holds millet and other seed in an uncovered tray that sits on four legs about 10 inches off the ground; it is useful for mourning doves. A hopper feeder, good for cardinals and other birds which prefer sunflowers, is a box that dispenses seed from the sides, and it can be mounted on a pole or suspended from a tree. A thistle feeder is a vertical tube with tiny slits in the side, designed for finches, and a suet feeder is a screened square or mesh bag through which a woodpecker or nuthatch can peck. Try to hang your feeder out of reach of squirrels, or use a baffle to protect it. Avoid feeding old bread and other kitchen scraps, as these items attract starlings and crows. Do not encourage mammals like deer and raccoons to feed on corn, apples, etc., in your yard—these species can become a neighborhood nuisance.



**NEST BOXES.** If possible, leave a dead tree or a trunk standing in your yard, where woodpeckers can make holes, which will in turn provide places for other wildlife to nest and raise their young. If there are no dead trees nearby, put up a bird house for cavity-nesting species such as the chickadee, nuthatch, wren and bluebird. The bird house should have some vent holes at the top and drainage holes on the bottom; it does not need a perch on the front. A bat box may be used by a small colony of little brown bats—important nighttime insect eaters.



**BRUSH PILES OR ROCK PILES.** Small animals such as chipmunks, rabbits, lizards and toads require suitable places to hide from predators. A small rock pile or brush pile constructed of medium-sized branches might be sited in an out-of-the-way place in your yard. Try hiding the pile with a native vine like Virginia creeper.

**\*\*An effective HABITAT AT HOME® functions as a small food web for many species.\*\***

Contact the Virginia Department of Game and Inland Fisheries for more information, at [HabitatAtHome@dgif.virginia.gov](mailto:HabitatAtHome@dgif.virginia.gov)

# Appendix C

## Conversion Chart

<b>Time</b> 1 hour = 60 minutes = 3,600 seconds 1 day = $8.64 \times 10^4$ seconds 1 year = 365 days = $3.15 \times 10^7$ seconds	<b>Area</b> 1 sq. in. = 6.4516 sq. cm 1 acre = 43,560 sq. ft. 1 sq. yd. = 9 sq. ft.
<b>Volume</b> 1 cu. ft. = 1,728 cu. in. = 28.231 liters 1 US gallon = 3.786 liters 1 liter = $3.531 \times 10^{-2}$ cu. ft. 1,000 liters = 1 cu. m. 27 cu. ft. = 1 cu. yd.	<b>Length</b> 1 ft. = 12 in. = 30.48 cm. 1 in. = 2.54 cm. 1 yd = 3 ft. = 91.44 cm. 1 m = 3.281 ft. = 39.37 in. 1 mile = 5280 ft. = 1760 yd.
<b>Temperature</b> $20^\circ \text{C} = 293 \text{ K} = 68^\circ \text{F}$ $^\circ \text{C} = 273 + \text{K}$ $^\circ \text{C} = (^\circ \text{F} - 32) / 1.8$	<b>Mass</b> 1 kg = 1,000 grams 1 kg = 2.2046 lbs. 1 US ton = 2,000 lbs.

# Appendix D

Scientific name	Common name	Region			Light			Moisture Zone				Interesting Features
		M	P	C	Sun	Part. Shade	Shade	1	2	3	4	
HERBACEOUS PLANTS - ANNUALS AND PERENNIALS												
<i>Acorus calamus</i>	Sweet flag	X	X	X	X	X	X	X	X			Spicy scent (entire plant)
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	X	X	X	X	X	X	X	X			Orchidlike green flower
<i>Asclepias incarnata</i>	Swamp milkweed	X	X	X		X	X	X	X			Purple flower cluster
<i>Caltha palustris</i>	Marsh marigold	X		X	X	X	X		X	X		White waxy flower
<i>Chelone sp</i>	Turtlehead	X	X	X	X						X	Pink or white flower
<i>Chrysogonum virginianum</i>	Green and gold	X	X	X	X	X				X	X	
<i>Eupatorium fistulosum</i>	Joe Pye Weed	X	X	X	X	X		X	X	X	X	Light lavender cluster flower
<i>Eupatorium perfoliatum</i>	Common boneset	X	X	X	X	X	X	X	X			White cluster flower
<i>Hibiscus moscheutos</i>	Eastern mallow	X	X	X	X	X		X	X			Large flower-var.colors
<i>Iris pseudacorus</i>	Yellow flag iris	X	X	X	X	X	X	X	X			Yellow delicate flower
<i>Iris virginica</i>	Virginia blue flag		X	X	X	X	X	X	X			Blue/mauve flower
<i>Lobelia cardinalis</i>	Cardinal flower	X	X	X	X	X	X	X	X	X		Bright red spike flower
<i>Lobelia siphilitica</i>	Great blue lobelia	X	X	X	X	X	X		X	X		Deep blue spike flower
<i>Martensia arvensis</i>	VA Blue bell	X	X	X		X	X	X	X	X		Delicate blue bell
<i>Mimulus rigens</i>	Monkey flower	X	X		X	X	X	X	X	X		Lavender flower
<i>Monarda didyma</i>	Bee balm	X	X		X	X			X	X		Scarlet fringe flower
<i>Phlox divaricata</i>	Woodland phlox	X	X			X	X		X	X		Purple/white flat flower
<i>Phlox paniculata</i>	Summer phlox	X	X	X	X	X	X	X	X	X	X	Pink flat flower
<i>Polemonium reptans</i>	Jacob's ladder	X	X	X	X	X	X			X	X	
<i>Pontederia cordata</i>	Pickrel weed	X	X		X	X	X	X	X			Purple spike glossy leaf
<i>Rudbeckia laciniata</i>	Cut leaved coneflower	X	X		X	X		X	X	X	X	Pink flat flower black center
<i>Saururus cernuus</i>	Lizard's tail		X	X		X	X	X	X			Heart leaf spike flower
<i>Solidago rugosa</i>	Rough-stemmed goldenrod	X	X	X		X	X	X	X	X	X	Yellow spike flower

REGION: M=Mountain P=Piedmont C=Coastal MOISTURE ZONE: 1=Very Wet 2=Moderately Wet 3=Moderately Dry 4=Dry



Scientific name	Common name	Region			Light			Moisture Zone				Interesting Features
		M	P	C	Sun	Part. Shade	Shade	1	2	3	4	
FERNS												
<i>Adiantum pedatum</i>	Maiden hair fern	X	X	X		X	X		X	X	X	Small leaf black stems
<i>Onoclea sensibilis</i>	Sensitive fern	X	X	X	X	X	X		X	X	X	Shiny black spikes
<i>Osmunda cinnamomea</i>	Cinnamon fern	X	X	X	X	X	X		X	X	X	Large rust spike
<i>Osmunda regalis</i>	Royal fern	X	X	X	X	X	X		X	X	X	Airy light green leaf
<i>Polystichum acrosticoides</i>	Christmas fern	X	X	X		X	X		X	X	X	Evergreen fronds
GRASSES/SEDGES/WEEEDS												
<i>Calamagrostis canadensis</i>	Blue joint reed grass	X			X	X			X	X	X	Grasses are good for cover and produce seeds of various sizes for wildlife
<i>Chasmanthium latifolium</i>	River oats, spanglegrass	X	X	X	X	X			X	X	X	
<i>Panicum virgatum</i>	Switch grass	X	X	X	X	X			X	X	X	
<i>Schizachyrium scoparium</i>	Little blue stem	X	X	X	X	X				X	X	
<i>Sorghastrum nutans</i>	Indian grass	X	X	X	X	X			X	X	X	
Rushes and sedges also add texture and diversity to rain gardens. They are very tolerant of full sun and very wet soils.												
Scientific name	Common name	Region			Light			Moisture Zone				Wildlife Value and Horticultural Interest
		M	P	C	Sun	Part. Shade	Shade	1	2	3	4	
SMALL TREES/SHRUBS												
<i>Alnus serrualta</i>	Smooth alder	X	X	X	X	X	X		X	X	X	Small cones and catkins/songbirds
<i>Amelanchier canadensis</i>	Service berry	X	X	X		X	X			X	X	Early white blooms
<i>Amorpha fruticosa</i>	False indigo		X	X		X	X			X	X	Quail and songbird cover/pods
<i>Photinia pyrifolia</i>	Red chokecherry	X	X	X	X	X	X			X	X	White blooms and fruits
<i>Asimina triloba</i>	Paw-Paw		X	X	X	X	X			X	X	Small oval green fruit/edible
<i>Calicarpa americana</i>	Amer. Beautyberry		X	X	X	X				X	X	Small bright purple fruit
<i>Carpinus caroliniana</i>	Amer. Hornbeam	X	X	X	X	X	X			X	X	Fluted bark/small nutlet
<i>Celtis occidentalis</i>	Hackberry	X	X	X	X	X			X	X	X	Corky bark/dark drupe fruit
<i>Cephalanthus occidentalis</i>	Buttonbush	X	X	X	X	X	X		X	X		Feathery bloom/pollinators
<i>Clethra alnifolia</i>	Sweet pepperbush	X	X	X	X	X	X			X	X	White spike bloom/nutlet
<i>Cornus amomum</i>	Silky dogwood	X	X	X	X	X				X	X	White flower/blue fruit/birds
<i>Cornus racemosa</i>	Graystem dogwood	X	X	X	X	X	X			X	X	Tan stem/blue fruit/birds
<i>Cornus sericea</i>	Red Twig dogwood	X	X	X	X	X	X		X	X	X	Red stem/white fruit/birds
<i>Fothergilla gardenii</i>	Witch alder	X	X	X	X	X			X	X	X	Bottlebrush spike white flower

REGION: M=Mountain P=Piedmont C=Coastal MOISTURE ZONE: 1=Very Wet 2=Moderately Wet 3=Moderately Dry 4=Dry

Scientific name	Common name	Region			Light			Moisture Zone				Interesting Features
		M	P	C	Sun	Part. Shade	Shade	1	2	3	4	
SMALL TREES/SHRUBS, continued												
<i>Hamamelis virginiana</i>	Witch hazel		X	X	X	X				X	X	Yellow fall flower
<i>Hibiscus aculeatus</i>	Hibiscus			X	X			X	X			Large flower/many colors/pollinators
<i>Hibiscus militaris</i>	Hibiscus			X	X			X	X			Large pink flower/pollinators
<i>Hibiscus moscheutos</i>	Marsh mallow		X	X	X			X	X			Large white flower/pollinators
<i>Ilex coriacea</i>	Sweet gallberry			X	X			X	X			Dull red drupe berry/birds in spring
<i>Ilex decidua</i>	Possumhaw		X	X	X	X		X	X	X	X	Orange to scarlet fruit
<i>Ilex glabra</i>	Inkberry holly		X	X	X	X	X	X	X	X	X	Blue-black berries/evergreen
<i>Ilex verticillata</i>	Winterberry holly	X	X	X	X	X	X	X	X	X	X	Red berries/deciduous
<i>Ilex vomitoria</i>	Yaupon holly			X		X	X	X	X	X	X	Scarlet drupe/evergreen
<i>Itea virginica</i>	Virginia sweetspire		X	X	X	X	X	X	X	X		Scarlet fall color
<i>Leucothoe racemosa</i>	Sweetbells	X	X	X	X	X	X	X	X	X		Red fall color/white bell flower
<i>Lindera benzoin</i>	Spice bush	X	X	X	X	X	X	X	X	X	X	Spicy scent/red fruit
<i>Lyonia lucida</i>	Fetterbush			X	X	X	X	X	X			Pink-white flower/evergreen
<i>Lyonia ligustrina</i>	Male berry		X	X	X			X	X			White flower/evergreen
<i>Magnolia virginiana</i>	Sweetbay magnolia		X	X	X	X	X	X	X	X	X	Sweet-scented white flower/semi-evergreen
<i>Morella cerifera</i>	South. wax myrtle		X	X	X	X	X	X	X	X	X	Spicy scent/waxy evergreen leaf
<i>Morella pensylvanica</i>	Bayberry	X	X	X	X			X	X	X	X	Spicy scent/semi-evergreen
<i>Ostrya virginiana</i>	East. hophornbeam	X	X	X	X	X	X	X			X	Nutlet and catkins/songbirds
<i>Physocarpus opulifolius</i>	Common ninebark	X	X		X			X	X	X		Peeling bark/large white flower/red fruit
<i>Rhododendron viscosum</i>	Swamp azalea	X	X	X			X	X	X	X		White flower/clove scent
<i>Rubus allegheniensis</i>	Allegheny bl. berry	X	X				X		X	X	X	Shiny blue berry/thorns/birds and small mammals
<i>Salix discolor</i>	Pussy willow		X	X	X	X	X	X	X			Large soft gray catkin
<i>Salix nigra</i>	Black willow	X	X	X	X			X	X			Catkins/songbirds
<i>Salix cottetii</i>	Bankers willow	X	X	X	X			X	X			Catkins/songbirds
<i>Sambucus canadensis</i>	Elderberry	X	X		X	X	X	X	X	X	X	Flat white flower/purple edible fruit
<i>Vaccinium corybosum</i>	Highbush blueberry	X	X			X	X	X	X	X		White flower/edible blue berry
<i>Viburnum cassinoides</i>	Wither Rod											Multi-colored fruit/bronze leaf color
<i>Viburnum dentatum</i>	Arrowwood	X	X	X	X	X	X	X	X	X	X	Dark blue drupe/birds
<i>Viburnum nudum</i>	Possumhaw	X	X	X	X	X	X	X	X	X	X	Lustrous red fall color

REGION: M=Mountain P=Piedmont C=Coastal MOISTURE ZONE: 1=Very Wet 2=Moderately Wet 3=Moderately Dry 4=Dry

Scientific name	Common name	Region			Light			Moisture Zone				Interesting Features
		M	P	C	Sun	Part. Shade	Shade	1	2	3	4	
MEDIUM TO LARGE TREES												
<i>Acer rubrum</i>	Red maple	X	X	X	X	X	X	X	X	X	X	Red leaves and twigs, red flowers in spring
<i>Betula nigra</i>	River birch	X	X	X	X		X		X	X	X	Tan peeling bark
<i>Betula lenta</i>	Sweet/Black birch	X	X		X	X	X			X	X	Cinnamon red bark
<i>Carya cordiformis</i>	Bitternut hickory	X	X	X	X		X		X	X		Large shade tree
<i>Diospyros virginiana</i>	Persimmon	X	X	X	X	X	X		X	X	X	Distinctive scaly bark
<i>Fraxinus americana</i>	White ash	X	X	X	X	X	X		X	X		Large shade tree, yellow to maroon fall color
<i>Fraxinus pensylvanica</i>	Green ash	X	X	X	X	X	X		X	X	X	Large shade tree, yellow to orange fall color
<i>Gleditsia aquatica</i>	Water locust		X	X	X				X			Fragrant yellow flowers
<i>Juglans nigra</i>	Black walnut	X	X	X	X	X	X		X	X	X	Grown for nuts, wood and wildlife
<i>Juniperus virginiana</i>	Eastern red cedar	X	X	X	X		X		X	X	X	Good screening specimen, grown for wildlife
<i>Liquidambar styraciflua</i>	Sweetgum	X	X	X	X	X	X		X	X	X	Fall color/yellow/purple
<i>Liriodendron tulipifera</i>	Yellow poplar	X	X	X	X		X		X	X	X	Yellow fall color, large yellow and green flowers
<i>Nyssa aquatica</i>	Water tupelo			X	X	X	X		X	X		Red fall color
<i>Nyssa sylvatica</i>	Black gum	X	X	X	X		X		X	X	X	Red fall color
<i>Oxydendrum arboreum</i>	Sourwood	X	X	X	X	X	X		X	X	X	Spring blooms, fall color
<i>Pinus taeda</i>	Loblolly pine		X	X	X		X		X	X	X	Wood, habitat and screening
<i>Platanus occidentalis</i>	Sycamore	X	X	X	X	X	X		X	X	X	Mottled white bark
<i>Populus deltoides</i>	Cottonwood poplar		X				X	X	X	X		Small seed/song birds, short-lived
<i>Quercus bicolor</i>	Swamp white oak	X	X	X	X	X	X		X	X		Acorns/deer/turkey/squirrels
<i>Quercus coccinea</i>	Scarlet Oak	X	X	X		X	X		X	X	X	Acorns/deer/turkey/squirrels, red fall color
<i>Quercus laurifolia</i>	Swamp laurel			X	X	X	X		X	X		Acorns/deer/turkey/squirrels
<i>Quercus lyrata</i>	Overcup oak	X	X			X	X	X	X	X		Acorns/deer/turkey/squirrels
<i>Quercus michauxii</i>	Swamp chestnut oak	X	X	X	X	X	X		X	X	X	Acorns/deer/turkey/squirrels
<i>Quercus nigra</i>	Water oak		X	X		X	X	X	X	X		Acorns/deer/turkey/squirrels
<i>Quercus palustris</i>	Pin oak	X	X	X	X		X		X	X		Acorns/deer/turkey/squirrels
<i>Quercus phellos</i>	Willow oak		X	X	X		X		X	X	X	Acorns/deer/turkey/squirrels

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Scientific name	Common name	Region			Light			Moisture Zone				Interesting Features
		M	P	C	Sun	Part. Shade	Shade	1	2	3	4	
MEDIUM TO LARGE TREES, continued												
<i>Quercus shumardii</i>	Shumard oak		X			X	X	X	X	X		Acorns/deer/turkey/squirrels
<i>Robinia pseudoacacia</i>	Black locust	X	X		X	X				X	X	Fragrant flowers
<i>Taxodium distichum</i>	Bald cypress		X	X	X	X		X	X	X	X	Deciduous needles
<i>Tsuga canadensis</i>	Eastern hemlock	X	X			X	X		X	X		Pendulous branches
<i>Ulmus rubra</i>	Slippery elm	X	X			X	X	X	X	X	X	Small round seed/birds

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**Virginia**  
**Department of Forestry**

Central Office

900 Natural Resources Drive, Suite 800  
Charlottesville, Virginia 22903

[www.dof.virginia.gov](http://www.dof.virginia.gov)

Phone: (434) 977-6555

Fax: (434) 296-2369

VDOF P00127; 05/2008